AGRICULTURE HANDBOOK NO. 136

estimating the amount of

CROP RESIDUE ON A FIELD

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
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Contents

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CROP RESIDUE ON A FIELD

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Purpose and Scope

This handbook has been prepared primarily for the use of Soil Conservation Service and Agricultural Conservation Program personnel. It is hoped that many others may also find use for it. Numerous occasions arise when it is important to know how much residue is on a field, in order to determine how well the land is protected against soil and water losses. This information may also serve as an aid in checking the efficiency of tillage methods used in a stubble-mulch system of farming.

Illustrations and accompanying explanations are given in subsequent pages, to show amounts of residue of different types on fields under different conditions of tillage.

To use this handbook, the reader should find a picture showing the kind of residue to be estimated. He should select one that resembles the appearance of the field, as nearly as possible. By comparing the picture with the field he can obtain a reasonably close estimate of the amount of residue on the land.

Maintenance of Residue

It has been determined by experiments, as well as by the experience of farmers, that crop residue left on the surface is a means of protecting the land. One way to provide protective residue is by a system of stubble-mulch farming. Such a system involves the use of implements which do not necessarily invert the soil and do not bury the residue. In most instances, use is made of sweep-type implements which loosen the soil by running beneath the surface. These are sometimes called subsurface tillers. Disk-type tools can be used to a limited extent, but they usually cover too much residue.

Residue cover causes the soil to absorb water more rapidly and thus reduces the total runoff. It also reduces the amount of soil lost by either water or wind erosion.

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Factors Involved in Soil Protection

The protection afforded a soil by residue depends on a number of conditions, including the—

Amount of residue on the surface.
Extent to which residue is anchored in the soil.
Length of pieces of residue.
Type of plant from which the residue came.
Extent of decay the residue has undergone.

The *amount of residue* needed to protect soil varies considerably with the way it is held in the soil. When approximately 1 ton of straw per acre is spread over the surface, a fair degree of protection against erosion by wind or water can be expected. Half that much straw may be equally effective if it consists of standing stubble. Under the most severe conditions, however, even a ton may not be sufficient. It should be emphasized that the amount of residue by weight is not as important as the kind of residue and the way it is anchored in the soil. When the amount is known, however, it is possible to arrive at a quick estimate of the overall protection afforded.

The *residue should be anchored in the soil*, as this prevents it from being washed off or blown away. This attachment to the soil may be through roots or clumps of roots on the stubble. Or residue may be held in the ground by being partly covered with soil. When the residue is held in the soil, it cannot be easily detached by either water or wind. Thus it is much more effective in protecting the soil than is residue which lies loose on the surface.

The *length of the pieces of residue* affects the efficiency of the cover. Straw residue, if broken into short pieces 1 to 3 inches long, may be light enough to be washed away or blown away. Straw may get into this condition when (1) shredding machines are used to shorten straw for the purpose of reducing the clogging of equipment; or (2) tractors and other machines, passing over the residue, tend to break it. Working when the straw is very dry also increases the breaking and shortening of the straw, as compared with working when it is damp.

The *kind of residue*—that is, *the type of plant from which it was obtained*—has an important bearing on its durability. Legume residue tends to decay rapidly. It contains high amounts of protein which supply nitrogen for the organisms that promote decay. However, some parts of legume plants, such as the coarse stems of second-year sweetclover, may be quite resistant to decay. The coarse parts of corn or sorghum stalks are quite durable, especially if they are on top of the soil. When partly buried so that they remain damp for a considerable time, they may decay rapidly. Wheat and rye straw are more resistant to decay than is oats straw.

The *extent to which decay has progressed* may determine the effectiveness of the cover. As residue decays, it gradually loses its capacity to cover or protect the soil. In instances where there is more residue than desired, a certain amount of decay is necessary to reduce the amount to a point where it is possible to operate machinery through it.

Estimating the Amount of Residue

The pictures presented in the following pages of this handbook are intended as a guide in estimating the amount of residue. They illustrate the effectiveness of different amounts and types of residue in protecting soil against erosion under a variety of conditions. It has been mentioned before, and should be emphasized again, that the kind and length of residue and the degree to which it is anchored in the soil also should be considered, in order to estimate the effectiveness of the residue in protecting the soil.

For a more exact method of estimating residue, based on simple calculations which have proved practical, the following procedure may be used: Make a sampler frame 2.95 feet square; this has an area of 1/5000 acre. Take five such samples of residue at random and combine them to give a sample of 1/1000 acre. Air-dry the material and weigh it to the nearest one-tenth pound. Divide this weight in pounds by two, and the result will be the number of tons of residue per acre.

A little practice in estimating the amounts from the pictures, however, should give estimates that are accurate enough for practical purposes.

BN–5196

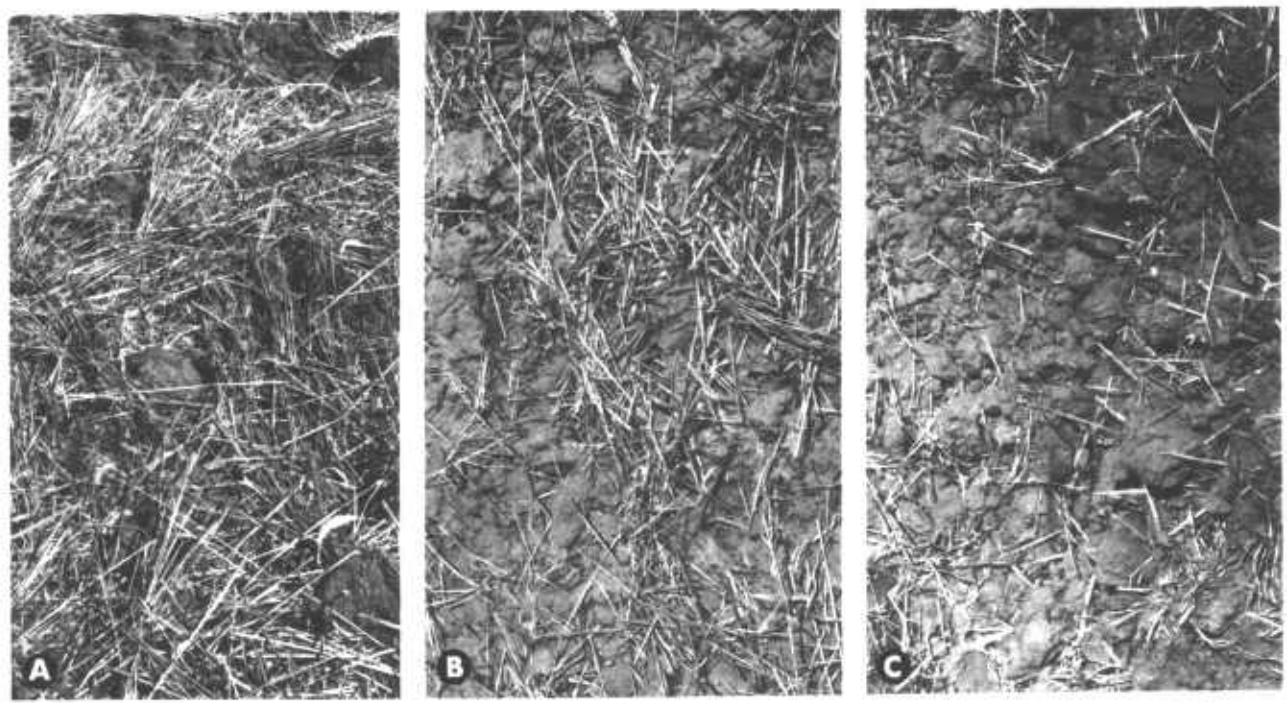
OATS RESIDUE AND OLD CORNSTALKS

Approximately 1.1 tons per acre of oats straw and 2-year-old cornstalks in spring will give good cover on sandy land planted to corn, provided this residue is carefully maintained on the surface. (Sandy Land Experiment Farm, Pierce, Nebr.)

BN–5207

OATS AND SWEETCLOVER RESIDUE

Oats stubble and first-year sweetclover residue in spring; total residue, 0.9 ton per acre. This residue is well distributed and gives excellent protection so long as most of it is kept on the surface. If proper subtillage methods are used, sufficient residue can be retained to protect the soil against runoff and erosion until the next crop is well started.



BN–5192

DIFFERENT AMOUNTS OF WHEAT RESIDUE PER ACRE LEFT ON SURFACE AFTER DIFFERENT DEGREES OF TILLAGE

A, 2.2 tons; *B*, 1.5 tons; *C*, 0.37 ton.

BN–5205

WHEAT RESIDUE IN WIND-EROSION AREA, FALLOWING

Approximately 2.2 tons of combine wheat stubble per acre. This was worked lightly soon after harvest with a one-way disk to start volunteer wheat and downy bromegrass. The stubble is still standing well enough to hold snow and prevent erosion by wind or water. (High plains of western Nebraska.)

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BN–5200

WHEAT RESIDUE IN WIND-EROSION AREA, FALLOWING

Approximately 2 tons of residue per acre at beginning of fallow season. This picture shows the condition on June 26, 1956, after 2 subtillage operations. (High plains of western Nebraska.)

BN—5203

WHEAT RESIDUE IN WIND-EROSION AREA

Only about 1.2 tons of wheat residue per acre, but since some is still standing, it will catch a certain amount of snow and reduce wind erosion. This field has had a light disking.

BN–5187

WHEAT RESIDUE IN WIND-EROSION AREA

Wheat stubble 8 to 10 inches high, approximately 0.5 ton per acre. While in the condition shown here, the field is fairly well protected against wind erosion. However, if this field should be tilled by even the most careful methods, the residue might be too little to protect the land, especially if the soil is an erosive type. (Hale County, Tex.)

BN–5190

WHEAT SEEDING ON SUMMER FALLOW LAND

Drilling wheat through approximately 1.25 tons per acre of heavy wheat residue on demonstration field in western Nebraska.

BN–5204

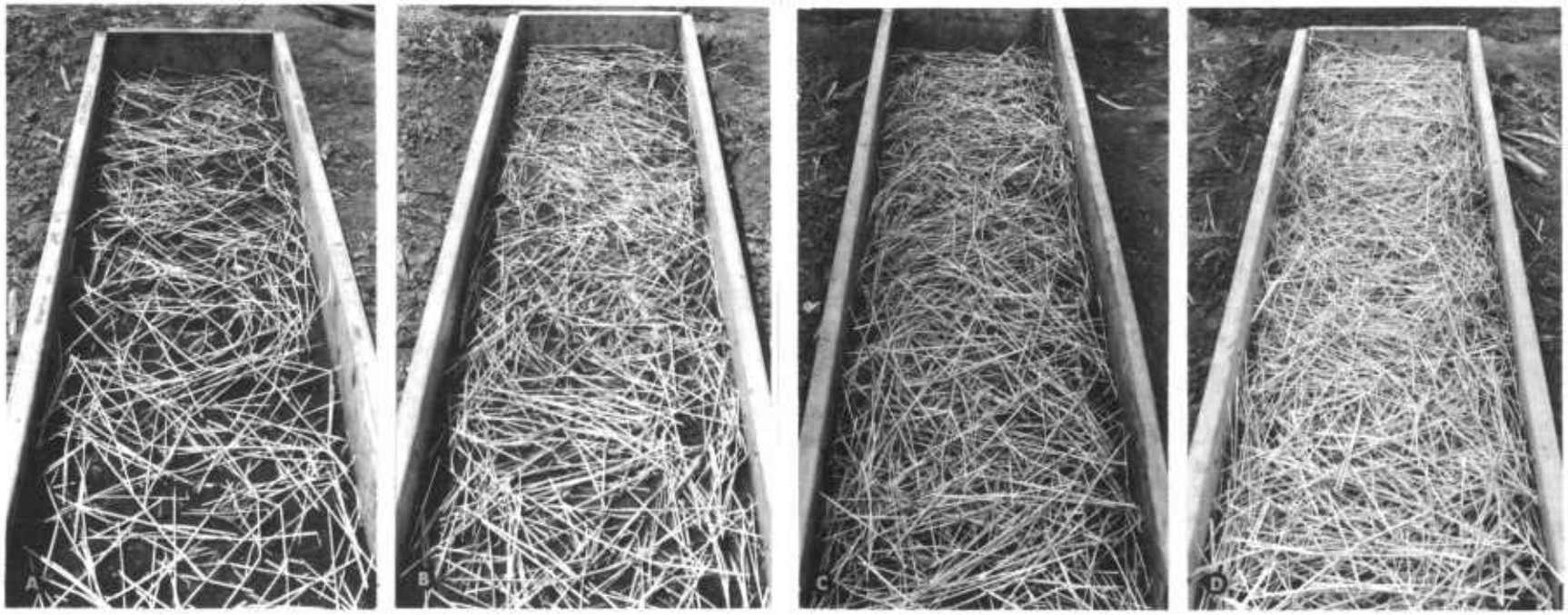
WHEAT SEEDING ON SUMMER FALLOW LAND

Wheat-straw residue on land fallowed with a subsurface tiller. Approximately 0.85 ton per acre of residue still on surface after drilling. This should give a fair degree of protection against wind erosion, but slightly more residue would be desirable, especially if the soil is sandy.

BN—5195

CORN PLANTING THROUGH WHEAT RESIDUE

Wheat residue, 2.3 tons per acre. The land has been prepared for corn with subsurface tillers and planted with a disk furrow-opener planter. This amount of residue should protect the land against severe runoff and erosion. This field, which is on a 6-percent slope, has been protected by such treatment over a 12-year period, and erosion has been negligible. (Near Lincoln, Nebr.)



BN—5194

APPEARANCE OF DIFFERENT AMOUNTS OF WHEAT STRAW SPREAD ON THE SOIL

These pictures give an idea of the visibility of soil through straw when the amounts per acre are (*A*) 0.25 ton, (*B*) 0.5 ton, (*C*) 1 ton, and (*D*) 2 tons.

BN–5201

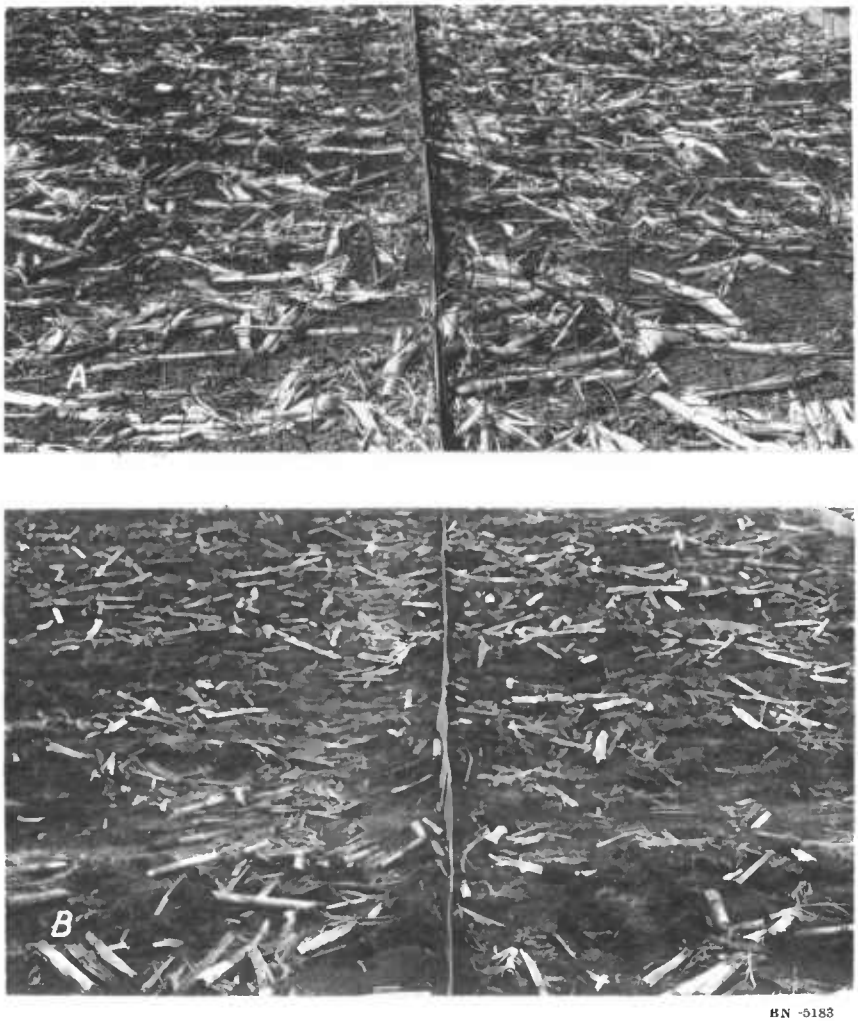
RYE AND PARTRIDGE-PEA RESIDUE ON SAND

Approximately 1.3 tons of residue per acre on sandy land gives good protection while standing. If care is taken to leave it on the surface, it will protect the soil for the next crop. (Sandy Land Experiment Farm, Pierce, Nebr.)

BN-5189

RYE AND VETCH RESIDUE FOR CORN PLANTING ON SAND

Approximately 2.5 tons per acre of residue on sandy land. Land was subtilled and planted to corn with short moldboard lister. This left plenty of residue on surface between rows to protect soil from blowing. (Pierce, Nebr.)



BN -5183

CORNSTALKS CUT INTO 12-INCH LENGTHS

A, Plots shown in spring with 2 tons per acre of residue; *B*, same plots after 6 months of weathering and cultivation with a subtiller equipped with wide sweeps. (Near Lincoln, Nebr.)

BN—5198

CORN RESIDUE IN FALL, ON ROLLING LAND

Corn residue after husking, approximately 1.8 tons per acre. Much of this will decay or blow away before planting time in the spring. If care is taken and the land is subtilled, enough residue should remain on the surface to give fair protection to the land the following year. (Loess hill region of eastern Nebraska.)

BN–5202

CORNSTALK RESIDUE IN SPRING

Approximately 1.5 tons per acre of cornstalks on the surface at time of planting the land back to corn. Many of the leaves and finer parts of the plants have been lost during the winter, but there is still sufficient residue to give effective protection against runoff and erosion. (Eastern Nebraska.)

BN–5188

LIGHT CORNSTALK RESIDUE IN SPRING

Land with about 0.75 ton per acre of light cornstalk residue. This amount should give some protection, but it would not be sufficient if the land is again planted to corn.

BN—5199

CORNSTALKS ON OATS LAND

Approximately 0.5 ton per acre of cornstalk residue. Oats have been seeded and are coming up. This small amount of residue following a dry year is too thin and scattered to give effective protection against erosion.

BN–5193

HEAVY SORGHUM STALKS IN SPRING

Approximately 2.5 tons per acre of this residue were present in the fall. The stalks were knocked down by the combine. Leaves have become largely disintegrated over winter, but the stalks still offer good protection to the soil. After such stalks are cut in the spring, they will continue to protect the soil while the next crop is getting started, provided they are left on the surface by subsurface tillage. (Near Lincoln, Nebr.)

BN—5197

SORGHUM RESIDUE ON IRRIGATED LAND

Approximately 1.5 tons of residue per acre on irrigated land which has been one-way disked once. Surface fairly well protected against wind erosion. If it had not been one-way disked, the field would have been almost completely protected. Later tillage should be done with sweep-type implements, or so much residue will be buried that much of its protective value will be lost. (Terry County, Tex.)

BN—5184

HEGARI STUBBLE ON IRRIGATED LAND

Irrigated hegari planted in 12-inch rows. Stubble 6 to 7 inches high, weighing approximately 0.5 ton per acre. This cover will provide good protection against wind erosion so long as it is not disturbed. Tillage for the next crop should be done with subsurface tillers, or so much residue will be lost that the soil will be exposed to severe wind erosion. Wind tunnel shown is used to measure effectiveness of stubble. (Lubbock County, Tex.)

BN–5186

MILO STUBBLE ON IRRIGATED LAND

Approximately 2.1 tons per acre of milo stubble; some regrowth of milo and weeds. Soil is heavily crusted and affords excellent protection against wind erosion. At 1 inch above ground, wind velocity was reduced by 90 percent. (Lubbock County, Tex.)

BN–5191

MILO STUBBLE ON DRY FARMING AREA

Approximately 0.43 ton per acre of milo stubble, 10 to 12 inches high. Surface is somewhat ridged and crusted. The soil is fairly well protected against wind erosion while this stubble is undisturbed. Not enough residue is present to protect the soil after it is tilled for the next crop. However, it will give some protection if care is taken to maintain as much as possible on the surface by subsurface tillage. (Lubbock County, Tex.)

BN–5206

SWEETCLOVER RESIDUE, CROP HARVESTED FOR SEED

Approximately 2.5 tons of residue per acre. This combination of high stubble and straw gives very effective protection against runoff and erosion. It is highly efficient in holding snow. Next year's crop is likely to have plenty of moisture and available nitrogen. (Eastern Nebraska.)

[2] See also OATS AND SWEETCLOVER RESIDUE, p. 7.

BN–5185

MOWED SWEETCLOVER, FLAT ON GROUND

Approximately 3 tons of second-year sweetclover residue which has been mowed and flattened by weather. This type of residue gives almost perfect protection against runoff and erosion, but it will not stop blowing snow.

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